UMQUAD 08

Eight-channel Quadrature Encoder Input Device

USER'S MANUAL

July 2011

No part of this manual may be reproduced without permission.

CyberResearch®, Inc.

www.cyberresearch.com

25 Business Park Dr., Branford, CT 06405 USA

203-543-5000 (9am to 5pm EST) FAX: 203-643-5001

©Copyright 2011
All Rights Reserved.

July 2011

The information in this document is subject to change without prior notice in order to improve reliability, design, and function and does not represent a commitment on the part of CyberResearch, Inc.

In no event will CyberResearch, Inc. be liable for direct, indirect, special, incidental, or consequential damages arising out of the use of or inability to use the product or documentation, even if advised of the possibility of such damages.

This document contains proprietary information protected by copyright. All rights are reserved. No part of this manual may be reproduced by any mechanical, electronic, or other means in any form without prior written permission of CyberResearch, Inc.

Trademarks

"CyberResearch®," and "UMQUAD 08" are trademarks of CyberResearch, Inc. Other product names mentioned herein are used for identification purposes only and may be trademarks and/or registered trademarks of their respective companies.

• NOTICE •

CyberResearch, Inc. does not authorize any CyberResearch product for use in life support systems, medical equipment, and/or medical devices without the written approval of the President of CyberResearch, Inc. Life support devices and systems are devices or systems which are intended for surgical implantation into the body, or to support or sustain life and whose failure to perform can be reasonably expected to result in injury. Other medical equipment includes devices used for monitoring, data acquisition, modification, or notification purposes in relation to life support, life sustaining, or vital statistic recording. CyberResearch products are not designed with the components required, are not subject to the testing required, and are not submitted to the certification required to ensure a level of reliability appropriate for the treatment and diagnosis of humans.
-

UMQUAD 08		
Revision No.	**Description**	**Date of Issue**
1.0	Initial Release	July 2011

Product Service

Diagnosis and Debug

CyberResearch, Inc. maintains technical support lines staffed by experienced Applications Engineers and Technicians. There is no charge to call and we will return your call promptly if it is received while our lines are busy. Most problems encountered with data acquisition products can be solved over the phone. Signal connections and programming are the two most common sources of difficulty. CyberResearch support personnel can help you solve these problems, especially if you are prepared for the call.

To ensure your call's overall success and expediency:

1) Have the phone close to the product so you can conveniently and quickly take action that the Applications Engineer might suggest.
2) Be prepared to open your products, remove boards, report back-switch or jumper settings, and possibly change settings before reinstalling the modules.
3) Have a volt meter handy to take measurements of the signals you are trying to measure as well as the signals on the board, module, or power supply.
4) Isolate problem areas that are not working as you expected.
5) Have the source code to the program you are having trouble with available so that preceding and prerequisite modes can be referenced and discussed.
6) Have the manual at hand. Also have the product's utility disks and any other relevant disks nearby so programs and version numbers can be checked.

Preparation will facilitate the diagnosis procedure, save you time, and avoid repeated calls. Here are a few preliminary actions you can take before you call which may solve some of the more common problems:

1) Check the PC-bus power and any power supply signals.
2) Check the voltage level of the signal between SIGNAL HIGH and SIGNAL LOW, or SIGNAL+ and SIGNAL– . It CANNOT exceed the full scale range of the board.
3) Check the other boards in your PC or modules on the network for address and interrupt conflicts.
4) Refer to the example programs as a baseline for comparing code.

Warranty Notice

CyberResearch, Inc. warrants that this equipment as furnished will be free from defects in material and workmanship for a period of one year from the confirmed date of purchase by the original buyer and that upon written notice of any such defect, CyberResearch, Inc. will, at its option, repair or replace the defective item under the terms of this warranty, subject to the provisions and specific exclusions listed herein.

This warranty shall not apply to equipment that has been previously repaired or altered outside our plant in any way which may, in the judgment of the manufacturer, affect its reliability. Nor will it apply if the equipment has been used in a manner exceeding or inconsistent with its specifications or if the serial number has been removed.

CyberResearch, Inc. does not assume any liability for consequential damages as a result from our products uses, and in any event our liability shall not exceed the original selling price of the equipment.

The equipment warranty shall constitute the sole and exclusive remedy of any Buyer of Seller equipment and the sole and exclusive liability of the Seller, its successors or assigns, in connection with equipment purchased and in lieu of all other warranties expressed implied or statutory, including, but not limited to, any implied warranty of merchant ability or fitness and all other obligations or liabilities of seller, its successors or assigns.

The equipment must be returned postage prepaid. Package it securely and insure it. You will be charged for parts and labor if the warranty period has expired.

Returns and RMAs

If a CyberResearch product has been diagnosed as being non-functional, is visibly damaged, or must be returned for any other reason, please call for an assigned RMA number. The RMA number is a key piece of information that lets us track and process returned merchandise with the fastest possible turnaround time.

PLEASE CALL FOR AN RMA NUMBER!

Packages returned without an RMA number will be refused!

In most cases, a returned package will be refused at the receiving dock if its contents are not known. The RMA number allows us to reference the history of returned products and determine if they are meeting your application's requirements. When you call customer service for your RMA number, you will be asked to provide information about the product you are returning, your address, and a contact person at your organization.

Please make sure that the RMA number is prominently displayed on the outside of the box.

• Thank You •

Table of Contents

Preface
About this User's Guide 10
What you will learn from this user's guide 10
Conventions in this user's guide 10
Where to find more information 10

Chapter 1
Introducing the UMQUAD 08 11

Chapter 2
Installing the UMQUAD 08 12
What comes with your UMQUAD 08 shipment? 12
Hardware 12
Optional components 13
Unpacking the UMQUAD 08 13
Installing the software 13
Configuring the channel input mode 14
Installing the hardware 15
Connecting the UMQUAD 08 to your system 15
Connecting the board for I/O operations 15
I/O connectors 15
Screw terminal pin out 17
37-pin connectors (J12 and J50) pin out 19
Cables 20
Field wiring, signal termination and conditioning 21
Connecting the UMQUAD 08 to an encoder 21

Chapter 3
Functional Details 23
UMQUAD 08 block diagram 23
External components 24
Screw terminal connections 25
37-pin connectors (J12, J50) 25
LED indicators 25
USB connector 25
Counter input modes 25
Quadrature mode 26
Totalize counter mode 27
Period measurement mode 28
Pulse width measurement mode 28
Synchronous/asynchronous scanning 28
Synchronous scanning 28
Asynchronous scanning 29
Debounce mode 29
Trigger after stable mode 29
Trigger before stable mode 30
Debounce mode comparisons 31

Digital input/output 32
Digital inputs 32
Digital outputs 32
Terminal count outputs 32
Timer outputs 33
Driving digital outputs 33
Triggering 34
Pacing 34
Power 34
Encoder power 34
Ground 35
Mechanical Drawings 35
Chapter 4
Specifications 36
Counter 36
Input 36
Digital I/O – Timer outputs – Terminal count outputs 37
Trigger and pacer 37
Indicator LEDs 37
Power 38
Environmental 38
Mechanical 38
USB specifications 38
Main connectors and pin out 39
Screw terminals 39
37-pin connectors 42
Declaration of Conformity 44

About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the UMQUAD 08 so that you get the most out of its USB data-acquisition features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example: Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example: *InstaCal* is the installation, calibration and test software supplied with this hardware.

Where to find more information

For additional information relevant to the operation of your hardware, refer to the *Documents* subdirectory where you installed the MCC DAQ software (C:\Program Files\Measurement Computing\DAQ by default), or search for your device on our website at www.cyberresearch.com.

Chapter 1

Introducing the UMQUAD 08

This user's guide contains all of the information you need to connect the UMQUAD 08 to your computer and to the signals you want to measure.

The UMQUAD 08 is a USB 2.0 high-speed device supported under popular Microsoft® Windows® operating systems, and is fully compatible with both USB 1.1 and USB 2.0 ports.

The UMQUAD 08 provides the following features:

- Eight counter inputs (quadrature/nonquadrature mode)
  - Simultaneous input and decoding of up to eight incremental quadrature encoders.
  - High-speed pulse counter for general counting applications; multiple counting modes supported
  - Configurable as single-ended or differential
  - 10 MHz, 16-, 32-, 48-bit resolution, ±12 volt input range
  - Indicator LEDs show the status of each counter/encoder input
  - 16 debounce settings
- Eight digital I/O bits
  - Configurable as input or output
  - Digital input bits accept voltage inputs up to 50 VDC (42.4 VPK)
  - Digital output bits are open collector, with clamping diodes for CEMF (counter-electromotive force) suppression
- Internal/external pacing
- Internal software trigger and external digital trigger

I/O connections are made to ten banks of detachable screw terminals or 37-pin D-type connectors. The 37-pin connectors are pin-compatible with the CYQUAD 04P for upgrade/migration from a PCI bus, although software migration is required.

The UMQUAD 08 is powered by the +5 volt USB supply from your computer. When operating in encoder mode, the UMQUAD 08 can pass an external supply connected to the ENC+IN screw terminal up to 50 VDC through the screw terminals (current rated at 1.5 A @ 5 VDC).

Chapter 2

Installing the UMQUAD 08

What comes with your UMQUAD 08 shipment?

As you unpack your UMQUAD 08, verify that the following components are included.

Hardware

- UMQUAD 08

- USB cable (2-meter length)

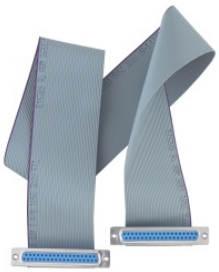
Optional components

If ordered, the following products should be included with your shipment.

Cables

CBL 3703-Q9

CBL 3710



CBL 3701*

*The **CBL 3701** is 1' in length and will be mentioned in this manual going forward. It is also available in a 2' length as **CBL 3702** and in a 3' length as **CBL 3703**.

ACC-202 Din-rail kit

Accessory for mounting a UMQUAD 08 to a standard DIN rail. Use the thread-forming screws to attach the DIN rail clip to your device.

Unpacking the UMQUAD 08

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the UMQUAD 08 from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If your UMQUAD 08 is damaged, notify CyberResearch immediately by phone, fax, or e-mail.

- Phone: 203-643-5000
- Fax: 203-643-5001
- Email: info@cyberresearch.com

Installing the software

Before installing your board in the computer, you should install and run *Insta*Cal™. *Insta*Cal is the installation, calibration, and test software supplied with your data acquisition / IO hardware. It will guide you through the hardware settings for your board. These settings are also detailed in the following section. The complete *Insta*Cal package is also included with

the Universal Library. If you have ordered the Universal Library, use the Universal Library disk set to install *Insta*Cal. The installation will create all required files and unpack the various pieces of compressed software.

Be sure you are using the latest system software

Before you install your UMQUAD 08, run Windows Update to update your operating system with the latest USB drivers.

Configuring the channel input mode

The counter inputs are configurable as single-ended (±12 V) or differential (±12 V; differential input ±14 V_{max}) mode via on-board switches (see Figure 1).

Figure 2 shows the locations for the counter input mode switches and the counter LEDs. Using the board orientation shown in Figure 2, slide the switch to the left (toward the USB connector) for single-ended mode, or to the right (towards the 37-pin connector) for differential mode. Note that the "dot" is visible on the switch when configured for differential mode, regardless of the board orientation.

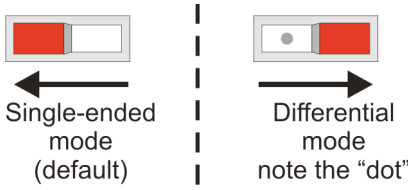


Figure 1. Channel input mode switch

By default, the board is shipped with the counter inputs configured for single-ended operation (as shown in Figure 2).

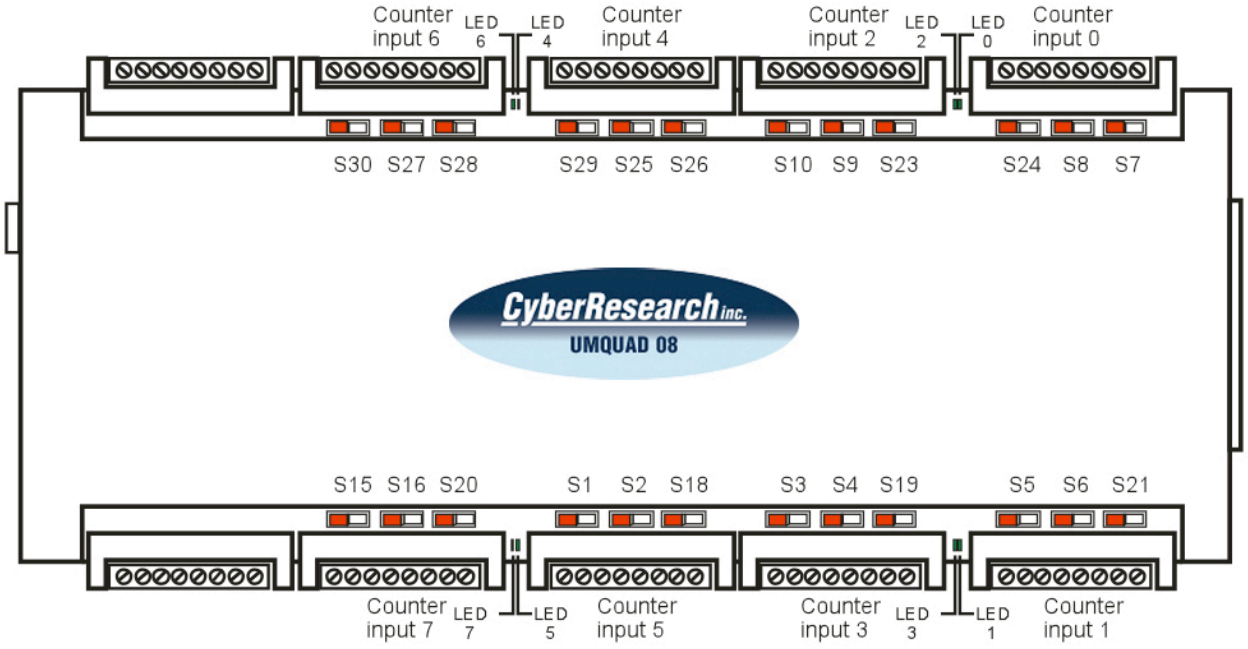


Figure 2. Switch and counter/encoder LED locations

Refer to the following table for the counter input associated with each switch.

	Counter input channel							
Input	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Phase A	S7	S5	S23	S3	S26	S1	S28	S15
Phase B	S8	S6	S9	S4	S25	S2	S27	S16
Index	S24	S21	S10	S19	S29	S18	S30	S20

Installing the hardware

Install the MCC DAQ software before you install your board
The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board.

Connecting the UMQUAD 08 to your system

To connect the UMQUAD 08 to your system, turn your computer on, and connect the USB cable to a USB port on your computer or to an external USB hub connected to your computer. The USB cable provides power and communication to the UMQUAD 08.

When you connect the UMQUAD 08 for the first time, a **Found New Hardware** popup balloon (Windows XP, Windows Vista) or dialog (other Windows versions) opens as the UMQUAD 08 is detected. Two drivers will be loaded — "MCC USB" and "UMQUAD 08". The installation is complete after the drivers are loaded and the dialog closes. The Status LED on the UMQUAD 08 should flash and then remain lit, indicating the UMQUAD 08 is communicating with your computer.

The Power LED blinks during device detection and initialization, and then remains solid. When the board is first powered on, a momentary delay may occur before the Power LED begins to blink, or come on solid.

If the Status LED turns off
If the Status LED lights up but then turns off, the computer has lost communication with the UMQUAD 08. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the LED should light again.

Connecting the board for I/O operations

I/O connectors

The table below lists the board connectors and applicable cables.

Board connectors, cables, and accessory equipment

Connector type	10 banks of detachable screw terminals Two 37-pin D type connectors — J12 and J50 (internal)

Compatible cable with the 37-pin connector	CBL 3703-Q9 CBL 3701 CBL 3710 CYSTP 372E CYSTP 37 CYSTP 37L CYSTP 37V CYSTP 37VL STA 01
Wire gauge range for screw terminals	16 AWG to 28 AWG

Caution! Be sure to correctly phase the encoder according to the instructions.

Screw terminal pin out

Differential mode

Signal Name	Signal Name
ENC+ OUT*	GND
0PHA+	1INDX–
0PHA–	1INDX+
0PHB+	1PHB–
0PHB–	1PHB+
0INDX+	1PHA–
0INDX–	1PHA+
GND	ENC+ OUT *
ENC+ OUT *	GND
2PHA+	3INDX–
2PHA–	3INDX+
2PHB+	3PHB–
2PHB–	3PHB+
2INDX+	3PHA–
2INDX–	3PHA+
GND	ENC+ OUT *
ENC+ OUT *	GND
4PHA+	5INDX–
4PHA–	5INDX+
4PHB+	5PHB–
4PHB–	5PHB+
4INDX+	5PHA–
4INDX–	5PHA+
GND	ENC+ OUT *
ENC+ OUT *	GND
6PHA+	7INDX–
6PHA–	7INDX+
6PHB+	7PHB–
6PHB–	7PHB+
6INDX+	7PHA–
6INDX–	7PHA+
GND	ENC+ OUT *
+5V_{USER} OUT	+5V_{USER} OUT
XTRIG	CLMP+ (DIO Supply + V_{DIO}) ****
XPCR	ENC+ IN*
GND	Supply GND
DIO0	DIO1
DIO2	DIO3
DIO4	DIO5
DIO6** (or Timer Output 0)	DIO7*** (or Timer Output 1)

* External supply when operating in encoder mode. ENC+ IN is passed to all ENC+ OUT lines with optional protection diodes to prevent a reverse connection.

** DIO6 can also function as Timer Output 0.

*** DIO7 can also function as Timer Output 1.

**** CEMF protection to the DIO supply; it is not a source.

Single-ended mode

Signal Name	**Signal Name**
ENC+ OUT*	GND
0PHA+	NC
NC	1INDX+
0PHB+	NC
NC	1PHB+
0INDX+	NC
NC	1PHA+
GND	ENC+ OUT*
ENC+ OUT*	GND
2PHA+	NC
NC	3INDX+
2PHB+	NC
NC	3PHB+
2INDX+	NC
NC	3PHA+
GND	ENC+ OUT*
ENC+ OUT*	GND
4PHA+	NC
NC	5INDX+
4PHB+	NC
NC	5PHB+
4INDX+	NC
NC	5PHA+
GND	ENC+ OUT*
ENC+ OUT*	GND
6PHA+	NC
NC	7INDX+
6PHB+	NC
NC	7PHB+
6INDX+	NC
NC	7PHA+
GND	ENC+ OUT*
+5V	+5V
XTRIG	CLMP+ (DIO Supply + V_{DIO}) ****
XPCR	ENC+ *
GND	Supply GND
DIO0	DIO1
DIO2	DIO3
DIO4	DIO5
DIO6** (or Timer Output 0)	DIO7*** (or Timer Output 1)

* External supply when operating in encoder mode. ENC+ IN is passed to all ENC+ OUT lines with optional protection diodes to prevent a reverse connection.

** DIO6 can also function as Timer Output 0.

*** DIO7 can also function as Timer Output 1.

**** CEMF protection to the DIO supply; it is not a source.

37-pin connectors (J12 and J50) pin out

The UMQUAD 08 has two 37-pin connectors. One connector (**J12**) is on the device right panel, and the other connector (**J50**) is internal to the device. Pin assignments for differential mode are shown in Figure 3. Pin assignments for single-ended mode are shown in Figure 4.

Caution! Be sure to correctly phase the encoder according to the manufacturer's instructions.

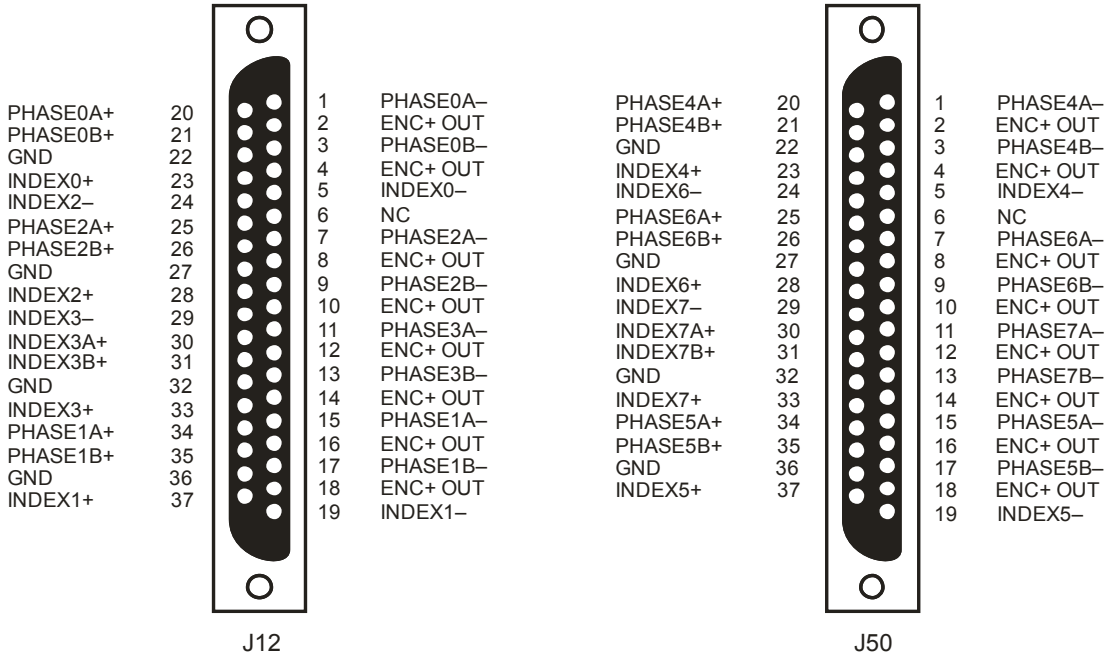


Figure 3. Differential mode pin out

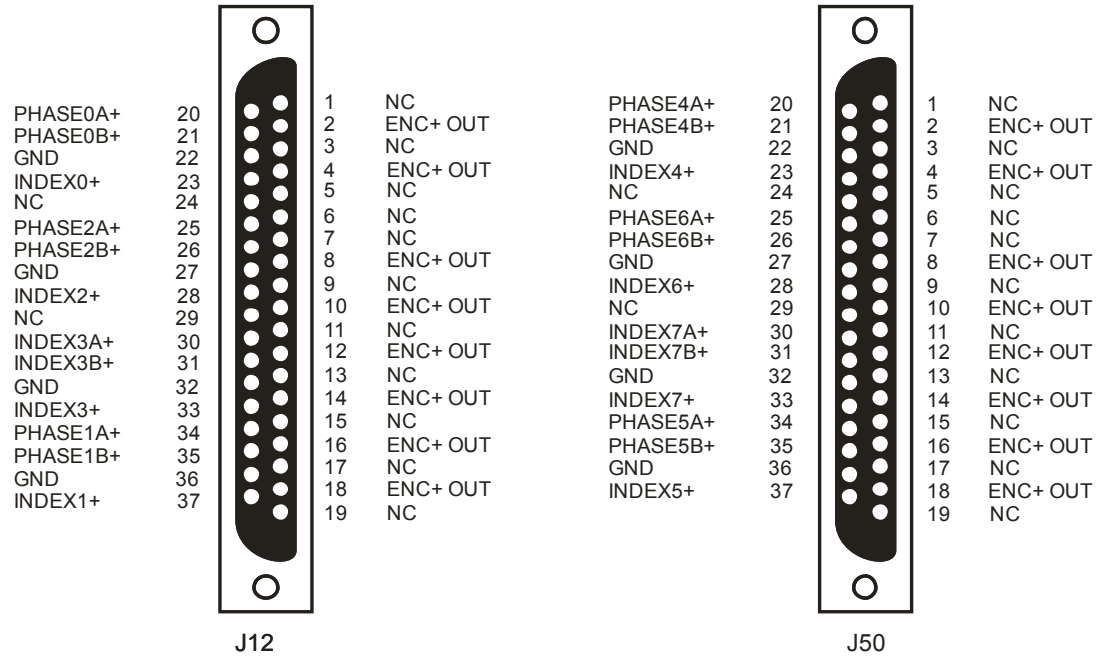


Figure 4. Single-ended mode pin out

Cables

CBL 3703-Q9 cable to 37-pin connector pin out

Connections from the board's 37-pin connector to the CBL 3703-Q9 cable are shown in Figure 5. Note that power to the encoders, the UMQUAD 08 passes an external supply from the ENC+ IN terminal to connected ENC+ OUT screw terminals.

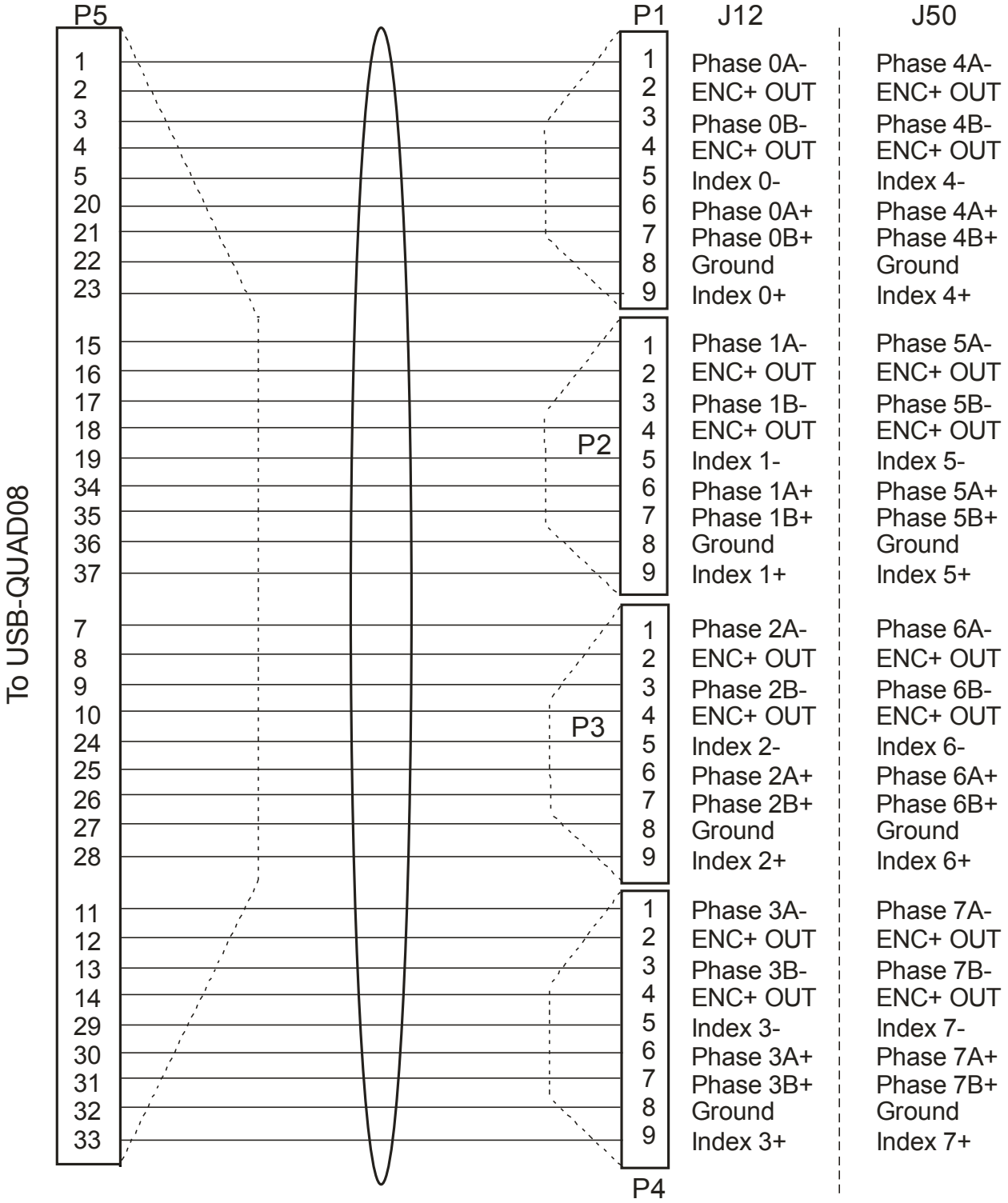

P5
P1
J12
J50
To USB-QUAD08
1 2 3 4 5 20 21 22 23
15 16 17 18 19 34 35 36 37
7 8 9 10 24 25 26 27 28
11 12 13 14 29 30 31 32 33
P2
P3
P4
1 2 3 4 5 6 7 8 9
Phase 0A- ENC+ OUT Phase 0B- ENC+ OUT Index 0- Phase 0A+ Phase 0B+ Ground Index 0+
Phase 1A- ENC+ OUT Phase 1B- ENC+ OUT Index 1- Phase 1A+ Phase 1B+ Ground Index 1+
Phase 2A- ENC+ OUT Phase 2B- ENC+ OUT Index 2- Phase 2A+ Phase 2B+ Ground Index 2+
Phase 3A- ENC+ OUT Phase 3B- ENC+ OUT Index 3- Phase 3A+ Phase 3B+ Ground Index 3+
Phase 4A- ENC+ OUT Phase 4B- ENC+ OUT Index 4- Phase 4A+ Phase 4B+ Ground Index 4+
Phase 5A- ENC+ OUT Phase 5B- ENC+ OUT Index 5- Phase 5A+ Phase 5B+ Ground Index 5+
Phase 6A- ENC+ OUT Phase 6B- ENC+ OUT Index 6- Phase 6A+ Phase 6B+ Ground Index 6+
Phase 7A- ENC+ OUT Phase 7B- ENC+ OUT Index 7- Phase 7A+ Phase 7B+ Ground Index 7+

Figure 5. 37-pin connector to the CBL 3703-Q9 cable pin out

CBL 3710 and CBL 3701 pin out

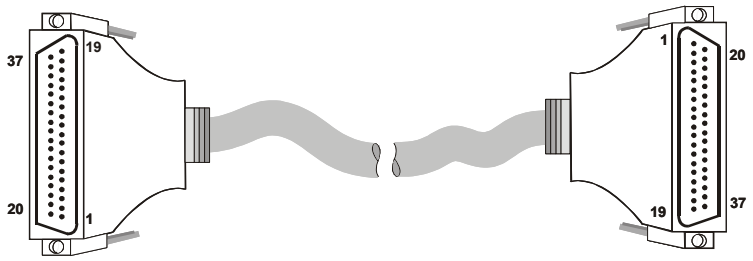


Figure 6. CBL 3710 cable

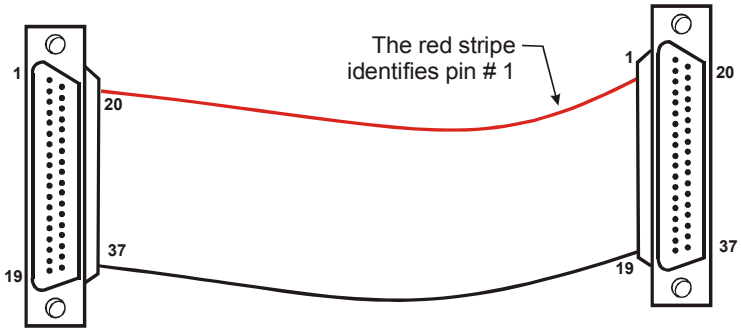


Figure 7. CBL 3701 cable

Field wiring, signal termination and conditioning

You can connect the UMQUAD 08 to the following accessory boards using the CBL 3701 or CBL 3710 cable.

- CYSTP 372E — Signal connection box, 37-conductor, shielded.
- CYSTP 37 — Universal screw terminal board, 37-pin.
- CYSTP 37L— Universal screw terminal board, 37-pin, detachable screw terminals.
- CYSTP 37V — Universal screw terminal board, 37-pin D male connector, vertical.
- CYSTP 37VL — Universal screw terminal board, 37-pin D male connector, vertical, detachable screw terminals.
- STA 01 — Universal screw terminal board, prototyping area 37 terminals.

Details on these products are available on our web site at www.cyberresearch.com.

Connecting the UMQUAD 08 to an encoder

Up to eight encoders can be connected to the screw terminals (*n*PHA, *n*PHB, and *n*INDX, where *n* is the number of the encoder (0 to 7) on the screw terminal). Up to four encoders can be connected to the 37-pin connector (PHASE*n*A, PHASE*n*B, and INDEX*n*, where *n* is the number of the encoder (0 to 3) on the 37-pin connector).

Encoder inputs are configurable in differential (±) or single-ended mode (+). Each A and B signal can be made as a single-ended connection with respect to the ±12V to common ground (GND).

To power the encoders, the UMQUAD 08 passes an external supply up to 50 VDC (current rated 1.5 A @ 5 VDC) through the **ENC+ IN** screw terminal. Diodes protect against reverse polarity.

Make the following connections to connect the UMQUAD 08 to an encoder:

- Connect encoder signals A, B, and Z to the A, B, and Index pins on the screw terminal or 37-pin connector.
- Connect the encoder ground to a ground (GND) terminal.
- Connect the encoder's power input to an **ENC+ OUT** screw terminal.
- Connect the supply return to a ground (GND) terminal.

Caution! Ensure that the signals are connected such that there is no potential between PC ground and signal ground.

Make sure that the current output specification is not exceeded.

Figure 8 below shows the differential input connections to one encoder.

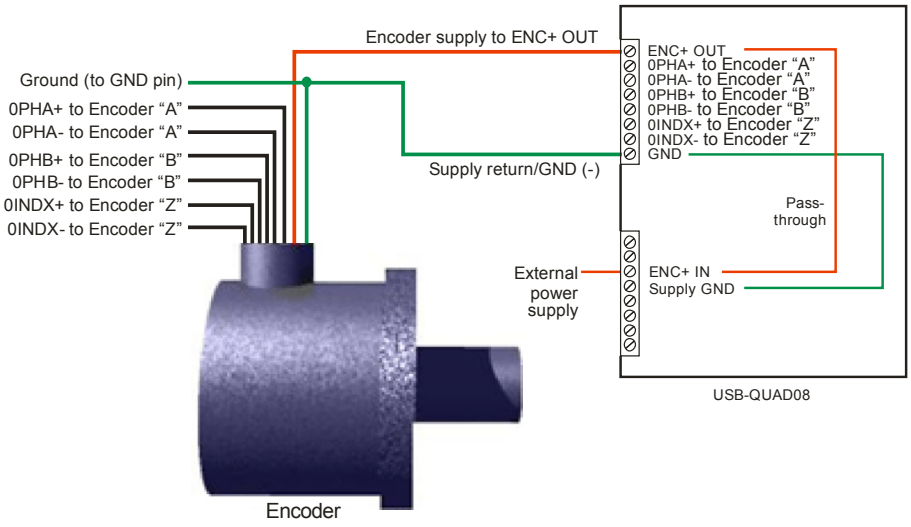


Figure 8. Differential encoder connections to the screw terminal or 37-pin connector

Figure 9 below shows the single-ended input connections to one encoder.

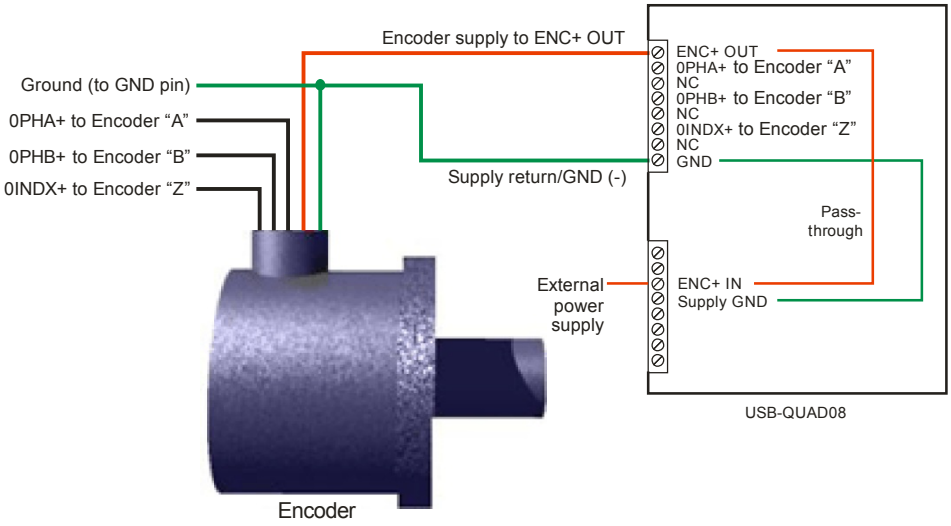


Figure 9. Single-ended encoder connections to the screw terminal or 37-pin connector

Chapter 3

Functional Details

UMQUAD 08 block diagram

UMQUAD 08 functions are illustrated in the block diagram shown here.

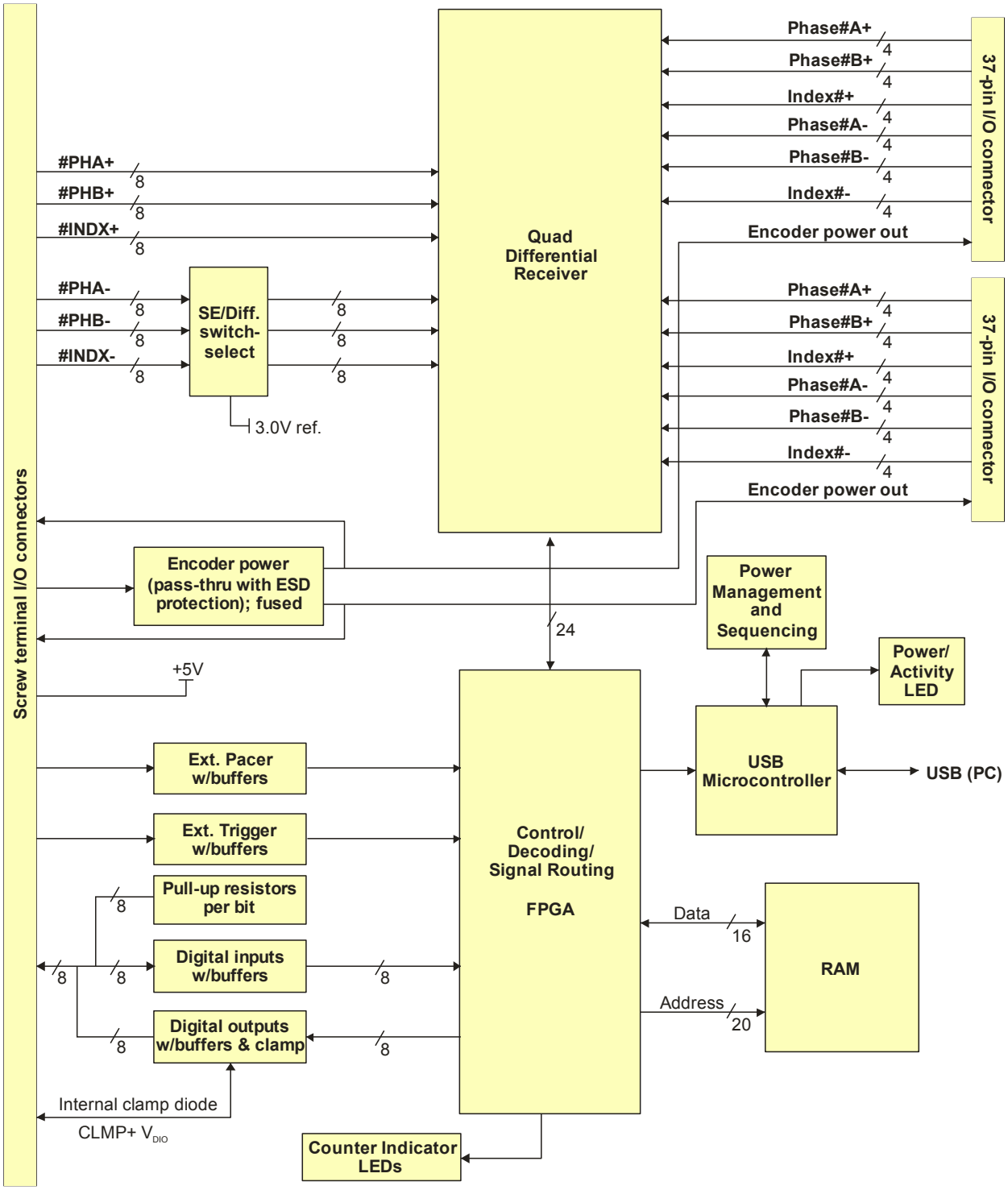
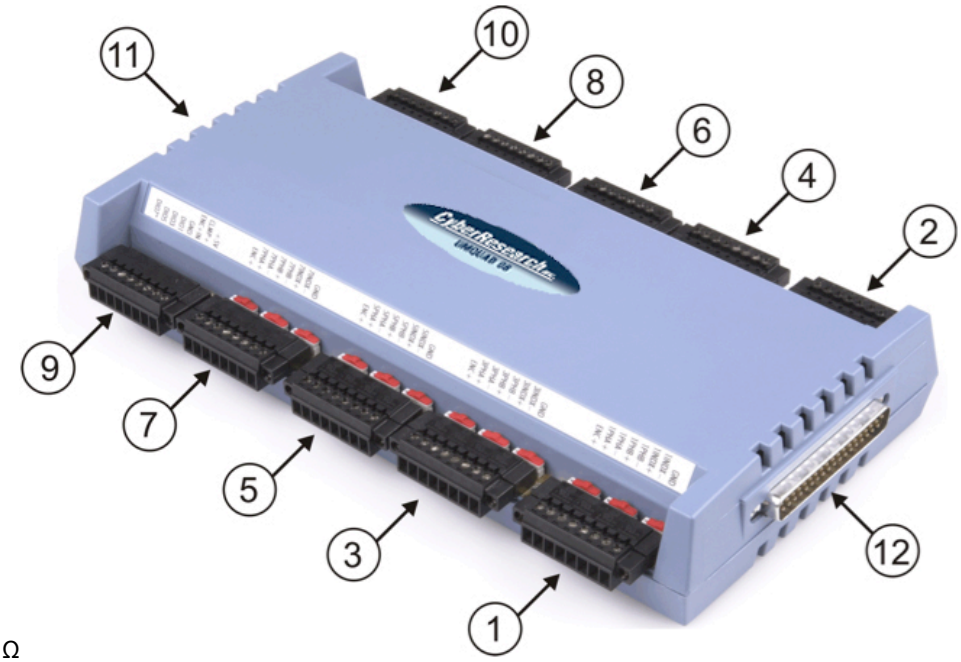


Figure 10. UMQUAD 08 functional block diagram

External components

The UMQUAD 08 has the following external components:

- 10 Screw terminal banks
- 37-pin I/O connector (J12)
- Device Power and Status LEDs
- USB connector
- Counter/encoder channel LEDs (not shown below, refer to Figure 2 on on page 14 for locations)



Ω

1	Counter input 1 connections	2	Counter input 0 connections	11	USB connector, Power and Status LEDs (device left side—see Figure 12)
3	Counter input 3 connections	4	Counter input 2 connections		
5	Counter input 5 connections	6	Counter input 4 connections		
7	Counter input 7 connections	8	Counter input 6 connections		
9	DIO1, 3, 5, 7, ENC+ IN, $+5V_{USER}$ OUT connections	10	DIO2, 4, 6, 8, XTRIG, XPCR, $+5V_{USER}$ OUT connections	12	37-pin I/O connector

Figure 11. UMQUAD 08 external components

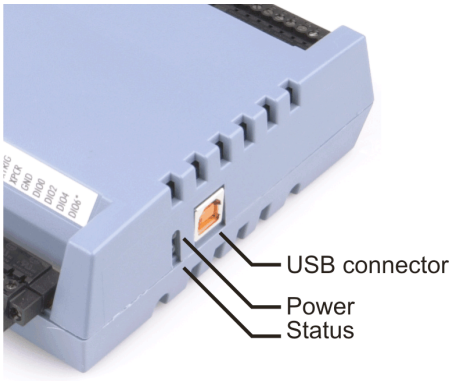


Figure 12. Power/Status LEDs, USB connector (device left side)

Screw terminal connections

The device has ten banks of detachable screw terminals that provide connections for the following:

- Eight encoder/counter inputs
- Eight DIO, or six DIO and two timer outputs
- Clamp for CEMF suppression (CLMP+ terminal reference to the +V DIO supply)
- External trigger input (XTRIG terminal)
- External pacer input (XPCR)
- External encoder power input (ENC+ IN) and encoder output (ENC+ OUT)
- Power outputs (+5V)
- Ground (GND)

37-pin connectors (J12, J50)

The UMQUAD 08 has two 37-pin D-type connectors (J12 and J50). Each connector provides Phase A, B, and Index connections for up to four quadrature encoder inputs. Connector J12 is on the right side of the device (as shown above). Connector J50 is internal — remove the device from the housing for access to this connector.

LED indicators

The left side of the device has LEDs for power and communication status (see Figure 12). Additionally, each encoder/counter channel has an associated status LED adjacent to its screw terminal bank. Refer to Figure 2 on page 14 for the location of the encoder/counter channel LEDs.

The table below lists the behavior of each LED.

LED Illumination

LED type	Indication
Power	Steady green: The device's microcontroller is connected to a computer or external USB hub.
Status	Steady green: communication is enabled. Blinking green: data is being transferred over the USB bus.
Channel	Steady/blinking green: the encoder/counter is receiving a valid signal on the channel input; otherwise this LED is off.

USB connector

The USB connector powers the UMQUAD 08, and provides communication between the UMQUAD 08 and computer.

Counter input modes

The UMQUAD 08 supports the following counter input modes:

- Counter (Quadrature / Totalize) mode
- Period measurement mode
- Pulse-width measurement mode

Counter operation modes are programmable with software. Some modes make use of a user-configurable value called the MAXLIMIT value. This value doesn't directly affect the current count, but sets a limit used in some modes to determine counter behavior.

All counter modes use the phase A input. Some modes also make use of the phase B and Index inputs.

Each mode supports additional submodes for counter operations. Refer to the discussion of each counter mode in the pages that follow for specific information.

Quadrature mode

The UMQUAD 08 can simultaneously decode signals from up to eight encoders. Quadrature encoders with 16-bit, 32-bit, or 48-bit counters, 10 MHz maximum pulse frequency, and X1, X2, and X4 count modes are supported.

The UMQUAD 08 provides Phase A (±), Phase B (±), and Index (±) inputs for each encoder connected (0°, 90°, and zero). Phase A and Phase B are generated at a 90° phase shift with respect to each other. Phase A and B signals are used to determine system position (counts), velocity (counts per second), and direction of rotation. The Index signal can be programmed to gate, latch the current count, decrement, or clear/reload the counter with the MAXLIMIT value.

The Index signal may be used to establish an absolute reference position within one count of the encoder rotation (360°). This signal can be used to reload the position counter, which is useful at system startup when the incremental encoder cannot determine the starting position of the motor.

The Terminal count / MAXLIMIT status can be output to the DIO terminals.

Each input can be debounced from 500 ns to 25.5 ms (total of 16 selections) to eliminate extraneous noise, or to switch induced transients. Encoder input signals must be within –12 V to +12 V, and the switching threshold is 200 mV differential or 200 mV above 3.0 V and 50 $mV_{typical}$ hysteresis. Refer to Debounce mode on page 29 for additional information.

The following options are supported in Quadrature mode:

Quadrature counter mode options

Counter mode	Description
Count mode	Select X1, X2, or X4. Count modes provide different levels of accuracy with respect to the encoder position. ▪ X1: counts rising edges on phase A (512 pulses). In X1 mode the encoder position is accurate to within 360° ÷ 512. ▪ X2: counts rising edges and falling edges on phase A (1024 pulses total). In X2 mode the encoder position is accurate to within 360 ° ÷ 1024. ▪ X4: count rising and falling edges on both phase A and phase B (1024 pulses on both phase A and phase B). In X4 mode the encoder position is accurate to within 360° ÷ 2048.
Range limit	When counting up: The counter stops when the maximum count (specified by the MAXLIMIT value) is reached. Counting resumes if direction is reversed or the counter is cleared. When counting down: The counter will count down to 0 and then stop. Counting resumes if direction is reversed or the counter is cleared.
Nonrecycle	The counter is disabled if a count overflow or underflow occurs or the MAXLIMIT value is reached. A clear command (via software or Index input) is required to re-enable the counter.
Modulo-N	Counting up: When the maximum count (specified by the MAXLIMIT value) is reached, the counter rolls over to 0 and continues counting up. Counting down: When the count reaches 0, the counter rolls over to the maximum count (specified by the MAXLIMIT value) and continues counting down.

Some Quadrature mode options are specific to the Index signal. These modes are listed below.

Index input mode options (Quadrature mode)

Counter mode	Description
Clear on Z	The counter is cleared on the rising edge of the Index signal.
Latching	Latching mode allows the count to be latched by the Index signal.

Totalize counter mode

The UMQUAD 08 can be used as a high-speed pulse counter for general counting applications. The counters can concurrently monitor time periods, frequencies, pulses, and other event driven incremental occurrences directly from pulse-generators, limit switches, proximity switches, and magnetic pick-ups.

Each counter can be configured with software as a 16, 32, or 48-bit counter. The counters can accept frequency inputs up to 10 MHz.

In Totalize mode, phase A is used as the primary counter input. Phase B can be used to set the count direction in up/down counting— by default, the counter counts up when phase B is high (1), and counts down when phase B is low (0). The Index input can be used to gate, latch, decrement the counter, or clear/reload the counter with the MAXLIMIT value. Counter inputs can be read either asynchronously or synchronously as part of a digital scan group.

The following options are supported in Totalize mode:

Totalize mode options

Counter mode	Description
Clear on read	The counter is cleared after each asynchronous read. The value of the counter before it was cleared is latched and returned.
Range limit	When counting up: The counter stops when the maximum count (specified by the MAXLIMIT value) is reached. Counting resumes if direction is reversed or the counter is reloaded. When counting down: The counter will count down to 0 and then stop. Counting resumes if direction is reversed or the counter is reloaded.
Nonrecycle	The counter is disabled if a count overflow or underflow occurs or the MAXLIMIT value is reached. A clear command (via software or Index input) is required to re-enable the counter.
Modulo-N	Counting up: When the maximum count (specified by the MAXLIMIT value) is reached, the counter rolls over to 0 and continues counting up. Counting down: When the count reaches 0, the counter rolls over to the maximum count (specified by the MAXLIMIT value) and continues counting down.
Up/down	Up/down counting mode uses phase A as the pulse source and phase B as the direction. By default, the counter counts up when phase B=1 (high), and counts down when phase B=0 (low).

Some Totalize mode options are specific to the Index signal. These modes are listed below.

Index input mode options (Totalize mode)

Counter mode	Description
Gating	Gating mode allows the index input to gate the counter. By default, the counter is enabled when the Index signal is high. When the Index signal is low the counter is disabled, but holds the count value.
Latching	Latching mode allows the count to be latched by the Index signal.
Clear/Reload	Clear/Reload mode allows the Index signal to reload the counter with the MAXLIMIT value.
Decrement	Decrement mode allows the Index signal to decrement the counter.

Period measurement mode

Use period mode to measure the period of a signal at a counter channel's phase A input. You can measure x1, x10, x100 or x1000 periods, 16-bit, 32-bit, or 48-bit values. Four resolutions are available — 20.83 ns, 208.3 ns, 2.083 µs, or 20.83 µs. All period measurement mode options are software-selectable. The 48 MHz system clock is used as the timing source. Periods from sub-microsecond to many seconds can be measured.

Counter channel inputs are read synchronously using period mode.

Pulse width measurement mode

Use pulse width mode to measure the time from the rising edge to the falling edge, or vice versa, on a signal on a phase A counter input. Four resolutions are available (20.83 ns, 208.3 ns, 2.083 µs, or 20.83 µs). All pulse width measurement mode options are software selectable. The 48 MHz system clock is used as the timing source. Pulse widths from sub-microsecond to many seconds can be measured..

Counter channel inputs are read synchronously using pulse width mode.

Synchronous/asynchronous scanning

Counter inputs can be read asynchronously under program control, or synchronously as part of a digital scan group.

Synchronous scanning

When read synchronously, the count of each channel's counter is set to 0 and latched at the beginning of the synchronous acquisition. Each clock pulse (*start-of-scan* signal) initiates a scan of all channels specified. Each time the UMQUAD 08 receives a *start-of-scan* signal, the counter values are latched and are available to the device. The values returned during scan period 1 are always zero. The values returned during scan period 2 reflect what happened during scan period 1. The scan period defines the timing resolution. To achieve a higher timing resolution shorten the scan period.

Use of terminal count outputs is not recommended in conjunction with synchronous reads

Counters are reset to 0 when scanning is initiated and counters are disarmed until the scan begins. This has the following affects on the terminal count outputs:

The terminal count output timing is affected by the reset when scanning is initiated.

When using an external trigger to initiate the synchronous acquisition, the counter is disarmed on all channels included in the scan until the trigger occurs.

Reloading the MAXLIMIT register interrupts the TC outputs.

Asynchronous scanning

When read asynchronously, counters can be configured so that they get set to 0 after each read, count up or down repeatedly, or count until the 16, 32, 48-bit, or a user-set limit has been reached. Refer to the counter mode descriptions below.

Debounce mode

The UMQUAD 08 has debounce circuitry which eliminates switch-induced transients that are typically associated with electro-mechanical devices including relays, proximity switches, and encoders.

All debounce options are software selectable. You can select a debounce time, debounce mode, and rising-edge or falling-edge sensitivity. Each channel can be debounced with 16 programmable debounce times in the range of 500 ns to 25.5 ms.

Two debounce modes (*trigger after stable* and *trigger before stable*) and a debounce bypass are shown in Figure 13. The signal from the buffer can be inverted before it enters the debounce circuitry. The inverter is used to make the input rising-edge or falling-edge sensitive.

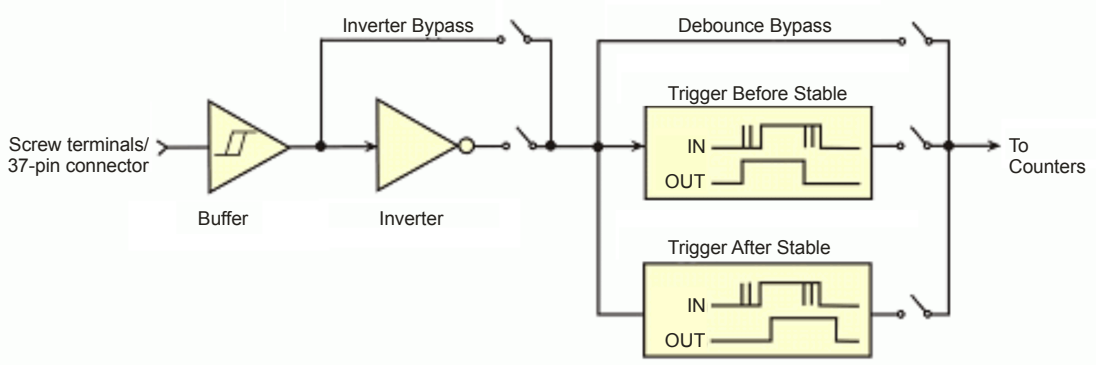


Figure 13. Debounce block diagram

Edge selection is available with or without debounce. In this case, the debounce time setting is ignored and the input signal goes straight from the inverter or inverter bypass to the counter module.

The two debounce modes are *trigger after stable* and *trigger before stable*. In either mode, the selected debounce time determines how fast the signal can change and still be recognized.

Trigger after stable mode

In the *trigger after stable* mode, the output of the debounce module does not change state until a period of stability has been achieved. This means that the input has an edge, and then must be stable for a period of time equal to the debounce time. Refer to Figure 14.

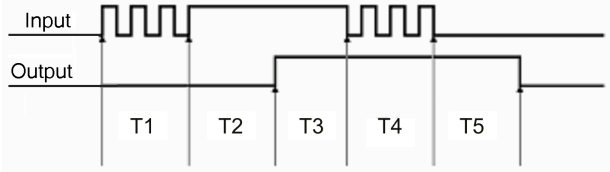


Figure 14. Trigger after stable mode

T1 through T5 indicate time periods. In trigger after stable mode, the input signal to the debounce module is required to have a period of stability after an incoming edge, in order for that edge to be accepted (passed through to the counter module.) For this example, the debounce time is equal to T2 and T5.

- T1 – In Figure 14, the input signal goes high at the beginning of time period T1, but never stays high for a period of time equal to the debounce time setting (equal to T2 for this example.)
- T2 – At the end of time period T2, the input signal has transitioned high and stayed there for the required amount of time—therefore the output transitions high. If the input signal does not stabilize in the high state long enough, no transition would have appeared on the output and the entire disturbance on the input would have been rejected.
- T3 – During time period T3, the input signal remained steady. No change in output is seen.
- T4 – During time period T4, the input signal has more disturbances and does not stabilize in any state long enough. No change in the output is seen.
- T5 – At the end of time period T5, the input signal has transitioned low and stayed there for the required amount of time—therefore the output goes low.

Trigger before stable mode

In the *trigger before stable* mode, the output of the debounce module immediately changes state, but will not change state again until a period of stability has passed. For this reason the mode can be used to detect glitches. Refer to Figure 15.

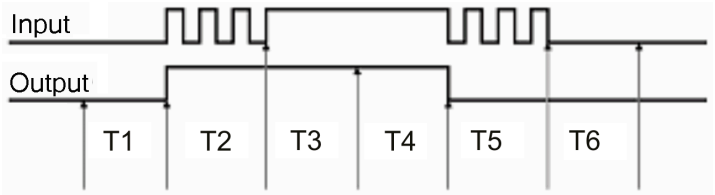


Figure 15. Trigger Before Stable mode

"T1" through "T6" in Figure 15 indicate time periods:

- T1 – The input signal is low for the debounce time (equal to T1); therefore when the input edge arrives at the end of time period T1, it is accepted and the output (of the debounce module) goes high. Note that a period of stability must precede the edge in order for the edge to be accepted.
- T2 – During time period T2, the input signal is not stable for a length of time equal to T1 (the debounce time setting for this example.) Therefore, the output stays "high" and does not change state during time period T2.
- T3 – During time period T3, the input signal is stable for a time period equal to T1, meeting the debounce requirement. The output is held at the high state. This is the same state as the input.
- T4 – At anytime during time period T4, the input can change state. When this happens, the output will also change state. At the end of time period T4, the input changes state, going low, and the output follows this action [by going low].
- T5 – During time period T5, the input signal again has disturbances that cause the input to not meet the debounce time requirement. The output does not change state.

- T6 – After time period T6, the input signal has been stable for the debounce time and therefore any edge on the input after time period T6 is immediately reflected in the output of the debounce module.

Debounce mode comparisons

Figure 16 shows how the two modes interpret the same input signal, which exhibits glitches. Notice that the *trigger before stable* mode recognizes more glitches than the *trigger after stable* mode. Use the **bypass** option to achieve maximum glitch recognition.

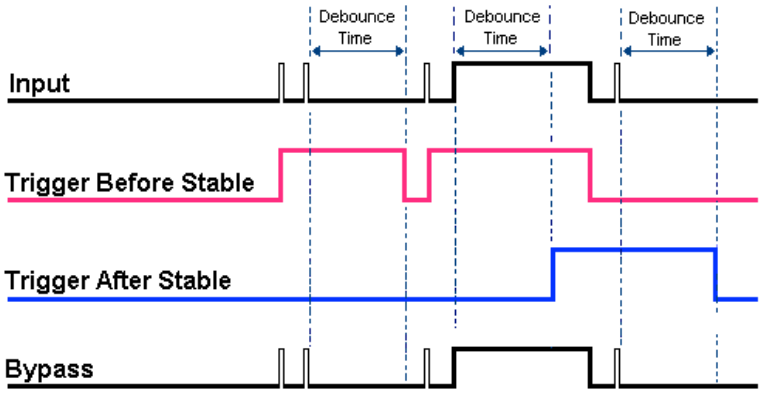


Figure 16. Example of two debounce modes interpreting the same signal

Set the debounce time according to the amount of instability expected in the input signal. Setting a debounce time that is too short may result in unwanted glitches clocking the counter. Setting a debounce time that is too long may result in an input signal being rejected entirely. Some experimentation may be required to find the appropriate debounce time for a particular application.

To see the effects of different debounce time settings, view the analog waveform along with the counter output. This can be done by connecting the source to an analog input.

Use *trigger before stable* mode when the input signal has groups of glitches and each group is to be counted as one. The trigger before stable mode recognizes and counts the first glitch within a group but rejects the subsequent glitches within the group if the debounce time is set accordingly. Set the debounce time to encompass one entire group of glitches, as shown in Figure 17.

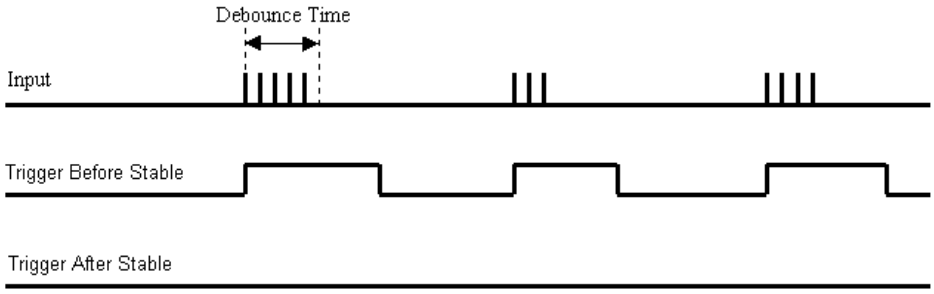


Figure 17. Optimal debounce time for "trigger before stable" mode

Trigger after stable mode behaves more like a traditional debounce function: rejecting glitches and only passing state transitions after a required period of stability. *Trigger after stable* mode is used with electro-mechanical devices like encoders and mechanical switches to reject switch bounce and disturbances due to a vibrating encoder that is not otherwise

moving. The debounce time should be set short enough to accept the desired input pulse but longer than the period of the undesired disturbance, as shown in Figure 18.

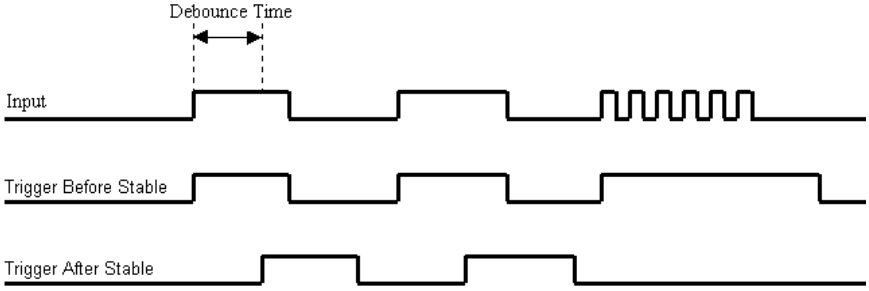


Figure 18. Optimal debounce time for "trigger after stable" mode

Digital input/output

The UMQUAD 08 has eight multipurpose digital bits (**DIO0** to **DIO7**) on the screw terminal. Each digital bit can be independently configured as a digital input, a digital output, or as a terminal count output for the corresponding counter channel. In addition, DIO6 and DIO7 can be configured as timer outputs with variable pulse width. When a digital channel is configured for terminal count or timer output, they cannot be used for digital I/O functions.

Digital inputs

Digital bits configured for input can accept high voltage inputs up to 42.4 V_{pk} or 50 VDC. The digital inputs are pulled high at power-up with a 10 kΩ series resistor to +5V with diode protection. This allows higher voltage inputs from the sourcing current to the UMQUAD 08.

Digital input bits are read asynchronously.

Digital outputs

Digital bits configured for output are open collector with an inductive diode clamped to the **CLMP+** terminal for CEMF (counter electromotive force) suppression. DO bits can withstand 50 volts, and can operate via software control (asynchronous). The asynchronous digital output throughput is 4000 updates/second, typical.

Terminal count outputs

When used as terminal count outputs, the digital bits at DIO0 – DIO7 indicate the count status for each corresponding counter channel. The output state will go high for the period of time that the count is equal to the terminal count value or the values specified as the MAXLIMIT.

For example, assume DIO0 is set for terminal count output. If counter 0 is configured for Range limit mode with MAXLIMIT set to 4096, the output of DIO0 will go high when the count reaches 4096 (counting up) or reaches 0 (counting down). It will remain high until counting resumes, either by a direction change or by a counter reload.

Similarly, if configured for Modulo-N counting, the same behavior applies except that, since this mode rolls over when the MAXLIMIT value is reached, a reset or direction change is not required to change the output state. Once the count moves off of MAXLIMIT (counting up) or 0 (counting down), the terminal count output goes low.

Timer outputs

Digital bits 6 and 7 (DIO6 and DIO7) can be used as 16-bit timer outputs. Each timer can generate a programmable pulse width wave with a programmable frequency in the range of 0. 01123 Hz to 5 MHz. At higher frequencies, the timer output frequency and duty cycle are dependent on the load impedance and the supply (refer to Driving digital outputs below for more information). The duty cycle is programmable.

The timer output rate and pulse width can be updated asynchronously at any time, however, doing so results in a pulse stream that is not seamless.

Driving digital outputs

The outputs are open-collector; effectively sinking current. The UMQUAD 08 has weak 10 kΩ resistors pulled up to +5V with overvoltage protection. Using this default configuration may not provide adequate drive for your application.

If minimum current is required, install a 250 Ω resistor from a digital output bit sinking from the $+5V_{USER}$ OUT terminal. Do not exceed 20 mA.

If a stronger drive strength is required, use an external supply with a series resistor up to 500 mA load per digital output pin. Do not exceed 2.5 A for the device. For CEMF protection, attach the external supply to the **CLMP+** terminal directly — do not install the supply after the series resistor.

Caution! Each output can sink up to 500 mA. Ensure that the entire device (up to 5 outputs) sinks less than 2.5 A. Alternately, all outputs can sink 300 mA.

Figure 19 below shows the digital output/timer output circuit.

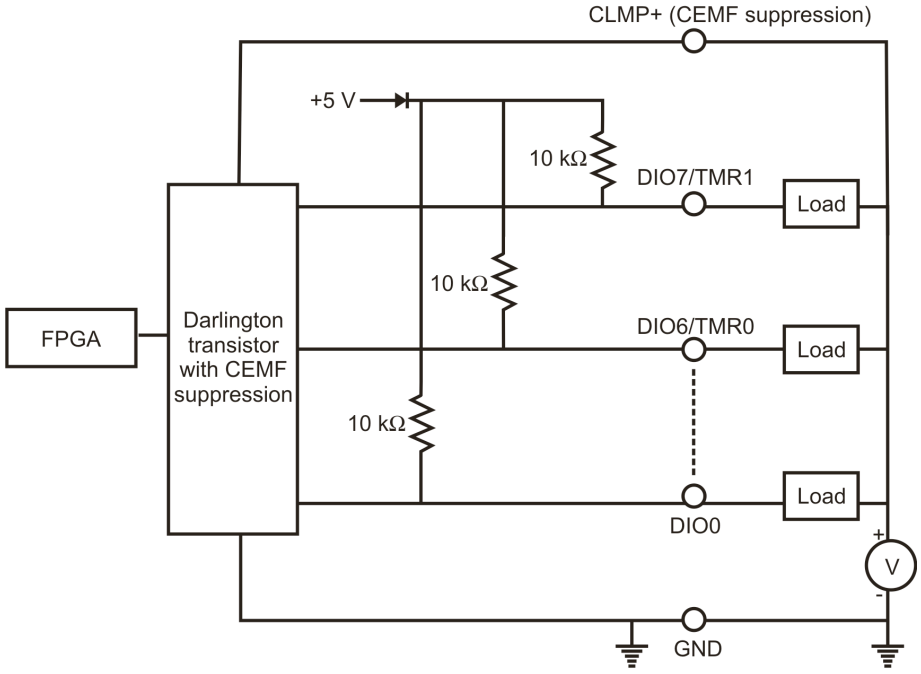


Figure 19. Digital/timer output channel circuit

Counter-electro-motive force (CEMF) suppression

Counter-electromotive force is the voltage, or electromotive force, that is induced into an inductor due to an alternating or pulsating current. CEMF is caused by a changing electromagnetic field, and is always in polarity opposite to that of the applied voltage.

Triggering

Synchronous acquisition of counter data can be triggered internally with software or externally using the **XTRIG** digital trigger input screw terminal.

The **XTRIG** input allows TTL-level triggering with latencies guaranteed to be less than 1 µs. The acquisition can be triggered on a rising or falling edge, or on a high or low level. The trigger input is TTL logic . Latency is one sample period, maximum. The input signal range is -0.5 to 7 V maximum. The logic level (1 or 0) and the rising or falling edge for the discrete trigger input are software selectable.

Pacing

Synchronous acquisition of counter data may be paced by the onboard clock, or by an external clock at the **XPCR** input terminal.

Power

The total supply current at the $+5V_{USB}$ terminal is 480 mA, maximum, including DIO. The total supply current shared between the $+5V_{USER}$ OUT terminals is 20 mA, maximum.

You can use the $+5V_{USER}$ OUT screw terminal pins to supply power to external devices or circuitry.

Caution! The $5V_{USER}$ OUT terminals are outputs. Do not connect to an external power supply or you may damage the UMQUAD 08 and possibly the computer.

Self-powered hub or laptop with external power adaptor required

The maximum total output current that can be drawn from all UMQUAD 08 connections (power, analog, and digital outputs) is 480 mA. This maximum applies to most personal computers and self-powered USB hubs. Bus-powered hubs and notebook computers may limit the maximum available output current to 100 mA.

The total current requirement of the UMQUAD 08 is 225 mA, typical. For an application running on a computer or powered hub, the maximum available excess current is 480 mA − 225 mA = 255 mA. This number is the total maximum available current at the $+5V_{USB}$ screw terminals.

Since some laptop computers running on battery power only allow up to 100 mA, the UMQUAD 08 may be above that allowed by the computer. In this case, you must either purchase a self-powered hub or operate the laptop computer from an external power adapter.

Encoder power

When operating in encoder mode, the UMQUAD 08 passes an external supply of up to 50 VDC (current rated 1.5 A @ 5 VDC) through the **ENC+ IN** screw terminal. Use the **ENC+ OUT** screw terminals to power up to eight encoders.

Ground

The ground (**GND**) connections provide a common ground for the digital, counter, and power connections.

Caution! Ensure that the signals are connected such that there is no potential between PC ground and signal ground.

Mechanical Drawings

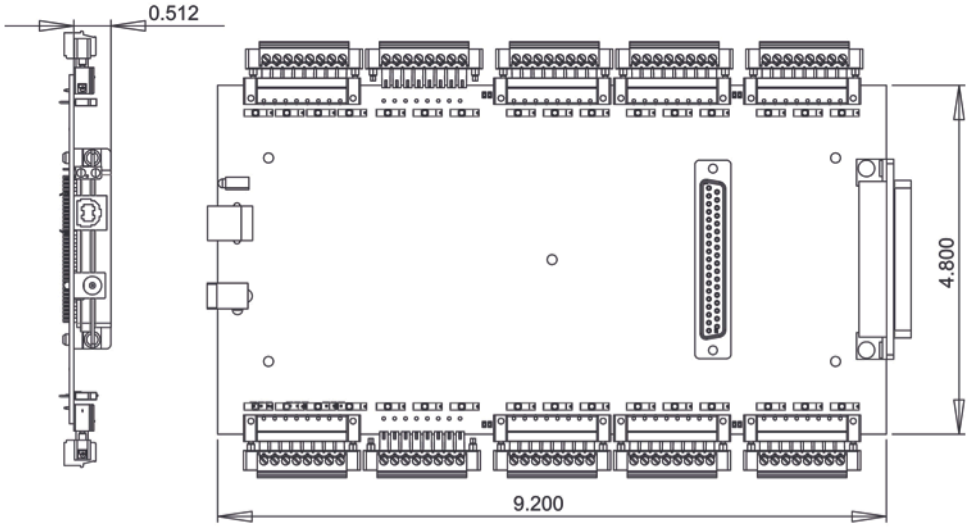


Figure 20. Circuit board dimensions

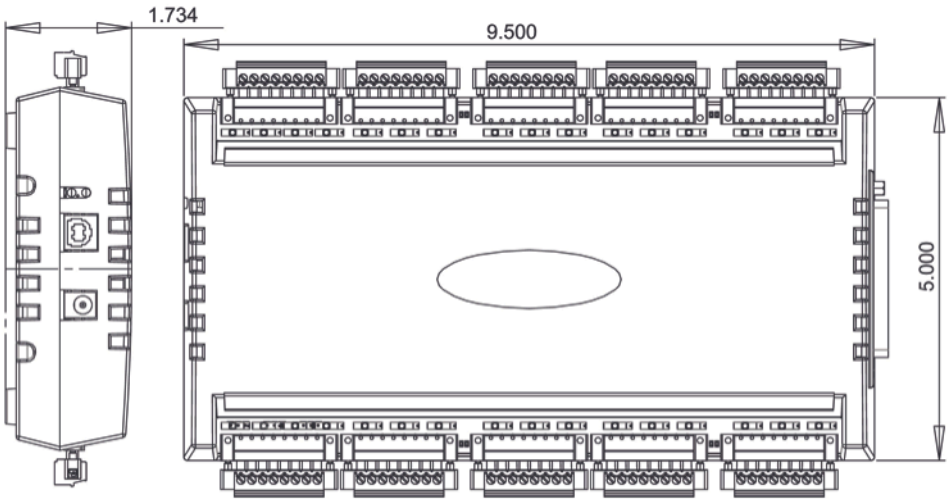


Figure 21. Housing dimensions

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Counter

Table 1. Counter specifications

Counter type	FPGA
Counters	8 (Quadrature or Normal)
Counter input modes	Quadrature (x1, x2, x4)/Totalize, Pulse-width, Period
Mode options	Non-Recycle, Range Limit, Clear on Read, Modulo-N, Up/Down, Decrement
Index options	Latch, Clear|Reload, Decrement, Gate (mode dependent)
Resolution	16, 32 or 48-bit counters
Quadrature mode input frequency	10/5/2.5 MHz, maximum, in x1/x2/x4
Normal mode input frequency	10 MHz, maximum
De-bounce times (programmable)	16 steps from 500 ns to 25 ms; positive or negative edge sensitive; glitch detect mode or de-bounce mode
Time-base and accuracy	48 MHz (24 MHz – 30 ppm with a 2xDLL (delay locked loop)
Counter read pacer	Internal or External scan pacer up to 8 MHz
Period/Pulse Width resolution	20.83 ns; 208.3 ns; 2.083 µs; or 20.83 µs

Input

Table 2. Input specifications

Receiver type	SN75ALS175 quad differential receiver
Configuration	Each channel consists of PhaseA input, PhaseB input and Index input; each input is selectable as single-ended or differential
	Differential: ▪ PhaseA, PhaseB and Index (+) inputs at user connector routed to (+) inputs of differential receiver. ▪ PhaseA, PhaseB and Index (–) inputs at user connector routed to (–) inputs of differential receiver.
	Single-ended: ▪ PhaseA, PhaseB and Index (+) inputs at user connector routed to (+) inputs of differential receiver. ▪ PhaseA, PhaseB and Index (–) inputs at user connector routed to ground. (–) inputs of differential receiver routed to +3 V reference.
Number of channels	8
Common mode input voltage range	*±12 V*
Differential input voltage range	*±12 V*
Input sensitivity	*±200 mV*
Input hysteresis	*50 mV, typical*
Input impedance	*12 kΩ, minimum*
Absolute maximum input voltage	*±14 V, maximum*
Miscellaneous	▪ *Meets or exceeds ANSI EIA/TIA-422-B, EIA/TIA-423-B, RS-485.* ▪ *Meets ITU recommendations V.10, V.11, X.26, X.27.* ▪ *Designed for multipoint busses on long lines and in noisy environments.*

Digital I/O – Timer outputs – Terminal count outputs

Table 3. Output specifications

Number of I/O	8 independent
Configurable	Timer outputs (DIO6, DIO7 only), Terminal count/Modulo, Input/Output (default);
Input:	
Input characteristics	Weak 10 kΩ resistor pulled-up to 5 V with protection diode (+V_{USB} – diode drop).
Input high	*+2.0 V to 42.4 V_{pk} 50 V_{DC}*
Input low	*0 to 0.8 V*
Output:	
Output characteristics	*Open-collector Darlington transistors with CEMF suppression diodes (ULN2803)*
Output logic supply	*User voltage supply up to 50 V_{DC}(42.4 V_{pk}) for strong drive.*
CEMF Supply (+VCLMP)	Connect to logic supply positive terminal up to *50 V_{DC}(42.4 V_{pk})*
Output high	*2.0 to 50 V_{DC}(42.4 V_{pk}) (dependent upon logic supply)*
Output low	<0.8 V
Output sink current	*500 mA per pin, 2.5 A max. per device (parallel connections for higher current needs) requires external supply.*
Output generation	Counter events or timer outputs (bits 6 and 7); asynchronous generation
Asynchronous throughput	4000 updates/second, typical (tested on Windows XP and Windows Vista 32)
Timers:	
Number of channels	Two 16-bit; DIO6 →Timer Output 0, DIO7 → Timer Output 1
Effective frequency range	0.01123 Hz to 5 MHz

Trigger and pacer

Table 4. Trigger and pacer specifications

Digital type	Edge/level sensitive (programmable)
Trigger types	Start acquisition process
Pacer	Latch counter values for read back
Trigger and pacer inputs	▪ Internal (software) ▪ External
Trigger and pacer input	–0.5 V to 7.0 V
External pacer frequency	8 MHz, maximum

Indicator LEDs

Table 5. LED specifications

Power LED	Indicates that the device's microcontroller has power and is running.
Status LED	Indicates that the USB is configured; blinks to indicate USB traffic.
Channel LED's	Indicates that the encoder/counter is receiving a valid signal on any of the inputs.

Power

Table 6. Power specifications

V_{USB} (+5V) (Note 1)	▪ Connected to self-powered hub ▪ Connected to externally-powered root port hub	4.5 V to 5.25 V 480 mA maximum; 225 mA typical
V_{USER} (+5V) current	4.5 V to 5.25 V; 20 mA maximum	
Encoder supply	External supply of 1.5 A @ 5 VDC fused up to 42.4 V_{pk} (50 V_{DC}) @ 2 A Protection diodes (30BQ060, 0.5 V_{max} drop) protecting against reverse polarity.	
Encoder supply Fuse	0452002. - Littelfuse 2A NANO$^{2®}$ Slo-Blo® Subminiature Surface Mount Fuse	

Note 1: "Self-powered hub" refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. "Root port hubs" reside in the PC's USB host Controller. The USB port(s) on your PC are root port hubs. All externally-powered root port hubs (desktop PC's) provide up to 500 mA of current for a USB device. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub. If your laptop PC is constrained to the 100 mA maximum, you need to purchase a self-powered hub.

Environmental

Table 7. Environmental specifications

Operating temperature range	0 to 60°C
Storage temperature range	–40 to 85°C
Humidity	0 to 90% noncondensing

Mechanical

Table 8. Mechanical specifications

Dimensions	245 mm (L) x 146 mm (W) x 50 mm (H) (9.6" x 5.7" x 2.0")

USB specifications

Table 9. USB specifications

Parameter	Specification
Device type	USB 2.0 high-speed mode (480 Mbps) if available (recommended), otherwise, USB 1.1 full-speed mode (12 Mbps)
Device compatibility	USB 2.0 (recommended) or USB 1.1
USB cable type	*A-B cable, UL type AWM 2725 or equivalent. (min 24 AWG VBUS/GND, min 28 AWG D+/D–)*
USB cable length	3 meters, maximum (9.84 feet)

Main connectors and pin out

Table 10. Main connector specifications

Connector type	10 banks of detachable screw terminals Two 37-pin D type connectors — J12(external) and J50 (internal)
Wire gauge range for screw terminals	16 AWG to 28 AWG
Compatible cable with the 37-pin connector	CBL 3703-Q9 CBL 3701 CBL 3710
Compatible accessory products	CYSTP 372E CYSTP 37 CYSTP 37L CYSTP 37V CYSTP 37VL STA 01

Screw terminals

Differential mode

Table 11. Differential mode pin out

Terminal signal	Terminal signal
ENC+ OUT (Note 2)	GND
0PHA+	1INDX–
0PHA–	1INDX+
0PHB+	1PHB–
0PHB–	1PHB+
0INDX+	1PHA–
0INDX–	1PHA+
GND	ENC+ OUT (Note 2)
ENC+ OUT (Note 2)	GND
2PHA+	3INDX–
2PHA–	3INDX+
2PHB+	3PHB–
2PHB–	3PHB+
2INDX+	3PHA–
2INDX–	3PHA+
GND	ENC+ OUT (Note 2)
ENC+ OUT (Note 2)	GND
4PHA+	5INDX–
4PHA–	5INDX+
4PHB+	5PHB–
4PHB–	5PHB+
4INDX+	5PHA–
4INDX–	5PHA+
GND	ENC+ OUT (Note 2)
ENC+ OUT (Note 2)	GND
6PHA+	7INDX–
6PHA–	7INDX+
6PHB+	7PHB–
6PHB–	7PHB+
6INDX+	7PHA–
6INDX–	7PHA+
GND	ENC+ OUT (Note 2)
+5V_{USER} OUT	+5V_{USER} OUT
XTRIG	CLMP+ (DIO supply +V_{DIO}) (Note 5)
XPCR	ENC+ IN (Note 2)
GND	Supply GND
DIO0	DIO1
DIO2	DIO3
DIO4	DIO5
DIO6* (Note 3)	DIO7* (Note 4)

Note 2: External supply when operating in encoder mode. ENC+ IN is passed to all ENC+ OUT lines with optional protection diodes to prevent reverse connection.

Note 3: DIO6 can also function as Timer Output 0.

Note 4: DIO7 can also function as Timer Output 1.

Note 5: CEMF protection to the DIO supply; it is not a source.

Single-ended mode

Table 12. Single-ended mode pin out

Terminal signal	Terminal signal
ENC+ OUT (Note 6)	GND
0PHA+	NC
NC	1INDX+
0PHB+	NC
NC	1PHB+
0INDX+	NC
NC	1PHA+
GND	ENC+ OUT (Note 6)
ENC+ OUT (Note 6)	GND
2PHA+	NC
NC	3INDX+
2PHB+	NC
NC	3PHB+
2INDX+	NC
NC	3PHA+
GND	ENC+ OUT (Note 6)
ENC+ OUT (Note 6)	GND
4PHA+	NC
NC	5INDX+
4PHB+	NC
NC	5PHB+
4INDX+	NC
NC	5PHA+
GND	ENC+ OUT (Note 6)
ENC+ OUT (Note 6)	GND
6PHA+	NC
NC	7INDX+
6PHB+	NC
NC	7PHB+
6INDX+	NC
NC	7PHA+
GND	ENC+ OUT (Note 6)
$+5V_{User}$ OUT	$+5V_{User}$ OUT
XTRIG	CLMP+ (DIO supply $+V_{DIO}$) (Note 9)
XPCR	ENC+ IN (Note 6)
GND	Supply GND
DIO0	DIO1
DIO2	DIO3
DIO4	DIO5
DIO6* (Note 7)	DIO7* (Note 8)

Note 6: External supply when operating in encoder mode. ENC+ IN is passed to all ENC+ OUT lines with optional protection diodes to prevent reverse connection.

Note 7: DIO6 can also function as Timer Output 0.

Note 8: DIO7 can also function as Timer Output 1.

Note 9: CEMF protection to the DIO supply; it is not a source.

37-pin connectors

J12

Table 13. Differential mode pin out

Pin	Signal Name	Pin	Signal Name
1	PHASE0A–	20	PHASE0A+
2	ENC+ OUT	21	PHASE0B+
3	PHASE0B–	22	GND
4	ENC+ OUT	23	INDEX0+
5	INDEX0–	24	INDEX2–
6	NC	25	PHASE2A+
7	PHASE2A–	26	PHASE2B+
8	ENC+ OUT	27	GND
9	PHASE2B–	28	INDEX2+
10	ENC+ OUT	29	INDEX3–
11	PHASE3A–	30	PHASE3A+
12	ENC+ OUT	31	PHASE3B+
13	PHASE3B–	32	GND
14	ENC+ OUT	33	INDEX3+
15	PHASE1A–	34	PHASE1A+
16	ENC+ OUT	35	PHASE1B+
17	PHASE1B–	36	GND
18	ENC+ OUT	37	INDEX1+
19	INDEX1–		

Table 14. Single-ended mode pin out

Pin	Signal Name	Pin	Signal Name
1	NC	20	PHASE0A+
2	ENC+ OUT	21	PHASE0B+
3	NC	22	GND
4	ENC+ OUT	23	INDEX0+
5	NC	24	NC
6	NC	25	PHASE2A+
7	NC	26	PHASE2B+
8	ENC+ OUT	27	GND
9	NC	28	INDEX2+
10	ENC+ OUT	29	NC
11	NC	30	INDEX3A+
12	ENC+ OUT	31	INDEX3B+
13	NC	32	GND
14	ENC+ OUT	33	INDEX3+
15	NC	34	PHASE1A+
16	ENC+ OUT	35	PHASE1B+
17	NC	36	GND
18	ENC+ OUT	37	INDEX1+
19	NC		

J50

Table 15. Differential mode pin out

Pin	Signal Name	Pin	Signal Name
1	PHASE4A–	20	PHASE4A+
2	ENC+ OUT	21	PHASE4B+
3	PHASE4B–	22	GND
4	ENC+ OUT	23	INDEX4+
5	INDEX4–	24	INDEX6–
6	NC	25	PHASE6A+
7	PHASE6A–	26	PHASE6B+
8	ENC+ OUT	27	GND
9	PHASE6B–	28	INDEX6+
10	ENC+ OUT	29	INDEX7–
11	PHASE7A–	30	PHASE7A+
12	ENC+ OUT	31	PHASE7B+
13	PHASE7B–	32	GND
14	ENC+ OUT	33	INDEX7+
15	PHASE5A–	34	PHASE5A+
16	ENC+ OUT	35	PHASE5B+
17	PHASE5B–	36	GND
18	ENC+ OUT	37	INDEX5+
19	INDEX5–		

Table 16. Single-ended mode pin out

Pin	Signal Name	Pin	Signal Name
1	NC	20	PHASE4A+
2	ENC+ OUT	21	PHASE4B+
3	NC	22	GND
4	ENC+ OUT	23	INDEX4+
5	NC	24	NC
6	NC	25	PHASE6A+
7	NC	26	PHASE6B+
8	ENC+ OUT	27	GND
9	NC	28	INDEX6+
10	ENC+ OUT	29	NC
11	NC	30	INDEX7A+
12	ENC+ OUT	31	INDEX7B+
13	NC	32	GND
14	ENC+ OUT	33	INDEX7+
15	NC	34	PHASE5A+
16	ENC+ OUT	35	PHASE5B+
17	NC	36	GND
18	ENC+ OUT	37	INDEX5+
19	NC		

CE Declaration of Conformity

Category:Electrical equipment for measurement, control and laboratory use.

CyberResearch declares under sole responsibility that the product

UMQUAD 08

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EC EMC Directive 2004/108/EC: General Requirements, EN 61326-1:2006 (IEC 61326-1:2005).

Emissions:

- EN 55011 (2007) / CISPR 11(2003): Radiated emissions: Group 1, Class A
- EN 55011 (2007) / CISPR 11(2003): Conducted emissions: Group 1, Class A

Immunity: EN 61326-1:2006, Table 3.

- IEC 61000-4-2 (2001): Electrostatic Discharge immunity.
- IEC 61000-4-3 (2002): Radiated Electromagnetic Field immunity.

To maintain compliance to the standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- All I/O cables must be shielded, with the shields connected to ground.
- I/O cables must be less than 3 meters (9.75 feet) in length.
- The host computer must be properly grounded.
- The host computer must be USB 2.0 compliant.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326-1:2006, or IEC 61326-1:2005.

Note: Data acquisition equipment may exhibit noise or increased offsets when exposed to high RF fields (>1V/m) or transients.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in May, 2009. Test records are outlined in Chomerics Test Report #EMI5334.09.

We hereby declare that the equipment specified conforms to the above Directives and Standards.

CyberResearch, Inc.
25 Business Park Drive
Branford, CT 06405
P: (203) 643-5000; F: (203) 643-50001
www.cyberresearch.com